PREDICTING SUCCESS OF NINTH GRADE MATHEMATICS STUDENTS IN MANHATTAN JUNIOR HIGH SCHOOL

by

JAMES L. REZAC

B. A., St. Benedict's College, 1960

A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Education

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1962

TABLE OF CONTENTS

INTRODUCTION. 1

REVIEW OF LITERATURE. 6

STATEMENT OF PROBLEM AND PROCEDURE. 12

DISCUSSION OF FINDINGS. 15

SUMMARY AND CONCLUSIONS 32

ACKNOWLEDGMENTS 35

LITERATURE CITED. 36

INTRODUCTION

The problem and obligations of the mathematics teachers have been greatly increased in recent years due to the advanced and growing interest in scientific development, such as space travel, sputniks, atomic energy, improvement in travel, communication, etc.

It has become apparent that if our nation is to cope with, or outdistance other nations in the field of scientific advancement, the mathematics curricula of our schools must be improved upon. The success of scientists, as well as economists and others, will depend largely upon their competency in the field of mathematics. This investigator feels that a scientific method is needed for proper guidance of those students enrolling in ninth grade mathematics.

The recent national demand for mathematicians and scientists, especially scientists with competency in mathematics, and the promise of scholarships to students showing exceptional ability and interest in these fields, has greatly increased the number of students enrolled in algebra, geometry, and other mathematics courses beyond arithmetic.

Administrators, counselors, and educators are seeking methods of encouraging those who have the ability and interest to embark on a successful mathematics career. Those students whose abilities and aptitudes do not indicate chances for success in algebra, geometry, and other more advanced mathematics courses need to be skillfully guided into other mathematics courses that will meet their needs and interests.

In 1916 a National Committee on Mathematical Requirements was organized under the auspices of the Mathematical Association of America for the purpose of making a comprehensive study of the whole mathematical program on secondary and college levels, including suggestions for the comparatively new, yet fairly well-established junior high school mathematics program.[1] In 1933, the Committee, then called a Commission to Study the Place of Mathematics in Secondary Education, was incorporated into a Joint commission of the Mathematical Association and the National Council of Teachers for organizing the work in ninth grade mathematics. The first was the traditional algebra course, the second, that of general mathematics. General mathematics was a kind of "fused" course in which some additional work in arithmetic and an intuitive geometry were combined with some of the simpler basic concepts of algebra. The purpose of the general mathematics course was to meet general educational needs in mathematics for those students who had neither the need for, nor the interest in, the traditional algebra and geometry sequence. The general mathematics movement spread rapidly in the junior high school.[2]

---

1. The National Committee on Mathematical Requirements. The Reorganization of Mathematics in Secondary Education. Boston: Houghton-Mifflin Co., 1927. pp. 6-7.

2. National Council of Teachers of Mathematics Fifteenth Yearbook. The Place of Mathematics in Secondary Education. New York: Bureau of Publication, Teachers College, Columbia University, 1940. p. 101.

It is assumed that there are certain basic concepts in mathematics which are essential for all students and that it is necessary to include in the mathematics curriculum those courses which will provide the mathematical competence which all future citizens need. It is also assumed that there are some who are academically qualified to reach outstanding proficiency in the field and will become the leaders in science, technology, industry, and business.

With the offering of two mathematics courses in the ninth grade came the problem of determining who should pursue the study of traditional algebra and who should be guided into the general mathematics course. Teachers of mathematics and counselors were faced with two significant problems. The first was recognizing and classifying varying degrees of mathematical ability among students; the second was concerned with the advising and counseling of students with regard to their interests and plans for the future.

It was the belief of many educators that some ninth grade students had not yet acquired a mathematical "readiness" for the abstract symbolism of algebra. Students might not have a working vocabulary of mathematical terms, nor a clear understanding of basic arithmetic principles when they were ready for the ninth grade. They could lack facility in fundamental skills, or a comprehension of relationships necessary to think in generalized terms.[1]

---

1. Edward A. Krug, Curriculum Planning. New York: Harper and Brothers, 1954.

There was reason to believe that some students lacked the necessary mental ability to do satisfactory work in mathematics, particularly in the formal course of algebra and geometry. Students were often enrolled in courses in which they had no chance for success because of lack of the necessary mental ability. On the other hand, some capable students avoided difficult subjects even though these subjects were needed as preparatory courses. Either of these situations represented educational waste of time and effort. To some extent, situations such as these could have been avoided by wise guidance based on careful prognosis.

> "The prediction of academic achievement is important from two standpoints. First, when an educational program is such that only a limited group can profit by it, predictions of the probable success of those who wish to take the course are important. Second, the prediction of academic achievement is important in the guidance of the individual student."[1]

The curriculum of Manhattan Junior High School has for many years offered both algebra and general mathematics in the ninth grade, and has recently offered geometry to a very small number of carefully selected ninth graders. The choice of courses presented the problem of guiding students into the subject which seemed most suitable for their future needs and the one in which they would be more likely to succeed. The accelerated program, in which a few students are selected to take geometry following eighth grade algebra is still in

---

1. Robert M. W. Travers, Educational Measurement. New York: The Macmillan Co., 1955.

the experimental stage as to whom should be included in this program. Also, the choice between general mathematics and algebra is largely left to the student with the advice of the counselor. It was felt that a study by which success in the various ninth grade mathematics courses could be predicted would be a great help in the guidance of these students. The problem was made more imperative by the presence of Kansas State University in which approximately 70 percent of Manhattan High School graduates enroll, many in engineering and other scientific and mathematical curriculums.

REVIEW OF LITERATURE

Until the beginning of the twentieth century the problem of predicting achievement was necessarily based on the principle that an individual would perform in the future as he had performed in the past. However, during the last three decades much progress has been made in the field of prognostic testing. In academic areas of study in which there are large numbers of failures there has been a real and persistent need to develop tests to be coupled with past achievement to be used eliminating those who were likely to fail.

From a survey of the literature that is concerned with prognosis and classification, it seemed that prediction studies had been of three types. First were those based on intelligence or elementary school marks; second, those that were analytic of the skill involved; and third, those that gave preliminary learning tests.

Of considerable interest in the guidance field has been the construction and use of prognostic or aptitude tests which supply reliable information by which can be predicted success or failure in algebra. Successful predictions have been made from tests which sample directly the individual's ability to learn by testing him in similar learning situations.

Probably more prognostic studies have been made in algebra than in any other field because of the need of finding a solution for the great number of failures.[1] Many of these

---

1. W. S. Guiler, "Forecasting Achievement in Elementary Algebra," Journal of Educational Research, September, 1944, p. 25.

studies have attempted to determine what single criterion or what multiple-combination of criteria were better predictors of success in algebra. A brief review of the work done on this problem of selecting and guiding ninth grade students into algebra and other ninth grade mathematics courses was helpful in outlining this study. The reports of these studies have been published in educational periodicals or were unpublished studies made by students working on graduate degrees.

The first attempt to measure mathematical ability was made by Rogers[1] in 1916. From a battery of tests including arithmetic, algebra, geometry, language tests, and Thorndike reading tests, Rogers developed the Rogers Tests of Mathematical Ability which were administered to 114 high school freshmen in two schools. The results of the tests were used for careful analysis of abilities in algebra, but not specifically for selection since algebra was a required subject at that time.

Orleans[2] was the first to deal with prognosis in high school mathematics using as criteria other factors in addition to intelligence quotients. Orleans studied the effect of a combination of criteria for predicting success in algebra. He tested over 300 students in New York City in 1926, using

---

1. Agnes L. Rogers, "Experimental Tests of Mathematical Ability and Their Prognostic Value," Teachers College Contribution to Education, No. 190., 1918.

2. Joseph B. Orleans, "A Study of Prognosis of Probable Success in Algebra and in Geometry," The Mathematics Teacher, May, 1934. pp. 225-246.

I. Q. scores, The Orleans Algebra Prognostic Test, and teachers' marks. His investigation revealed that nearly sixty percent of all failures in algebra were found in the lower quartile of the distribution of the algebra test scores, while only thirty-six percent of failures were in the lower quartile of the distribution of the I. Q. scores, and forty-three percent were in the lower quartile of the distribution of teachers' marks. Orleans concluded that the prognostic test indicated a better possibility of determining success in algebra.

As a result of a study by Lee and Hughes[1] in California, it was found that the aptitude test gave the best single predictor of achievement as measured by standardized tests. However, teachers' ratings of previous mathematical ability correlated higher with teachers' marks received by pupils in algebra or geometry.

A recent and extensive study was conducted by Shaw[2] in New York with 387 freshmen. The purpose of the study was to consider the factors of I. Q., reading ability, and "algebraic aptitude" in various mulitiple-combinations, and also as isolated factors in an attempt to produce greater accuracy of prediction. The Iowa Algebra Aptitude Test was given at the end of the eighth year while The Otis Quick Scoring Mental Ability Test

---

1. J. Murray Lee and W. Hardin Hughes, "Predicting Success in Algebra and Geometry," School Review, March, 1934, pp. 188-196.

2. Geraldine Sax Shaw, "Prediction of Success in Elementary Algebra," The Mathematics Teacher, March, 1956, pp. 173-178.

and The Iowa Silent Reading Test were given at the beginning of the ninth year. Two criteria were used for success at the close of the year's course. They were a departmental final examination devised by the mathematics department, and the Lankton First Year Algebra Test. The conclusions of the study were that The Iowa Algebra Aptitude Test, The Otis Quick Scoring Mental Test, and The Iowa Reading Test were, in descending order, good indicators of group success in algebra. A greater degree of success was indicated by using the combined scores of the three tests. Shaw recommended an area for further investigation to determine cutoff scores and multiple screening, not to eliminate students from enrolling in algebra, but to identify those who may have difficulty, but can succeed in algebra if placed in classes that proceed at a slower rate.

Major findings of McMillan[1] in a study of 236 pupils indicated that marks in eighth grade arithmetic seemed a good predictor of success in elementary algebra, although a test of algebraic ability was helpful.

Layton[2] administered a battery of tests to students in Jackson, Mississippi. Contradictory to many studies made in algebra prognosis, Layton's conclusion was that the eighth

---

1. LaVerne Ruth McMillan, A Comparative Study of the Prediction of Achievement in Ninth Grade Algebra. Unpublished Master's Thesis, The University of Texas, 1957.

2. R. B. Layton, "A Study of Prognosis in High School Algebra," Journal of Educational Research, April, 1941. pp. 601-605.

grade mathematics mark was the best single criterion for indicating achievement in algebra. He found a correlation of .82 between eighth grade mathematics marks and mathematics achievement tests scores.

Ayres,[1] Douglass,[2] and Dickter[3] made studies of the effectiveness of using a composite of three criteria for predicting success in elementary algebra. The three criteria included an intelligent quotient, a prognostic test, and teachers' marks. Results indicated that a combination of criteria predicted more accurately than a single test.

It seemed of value to refer to a recent survey by Robert Benignus,[4] a mathematics teacher of Kansas. In his Master's report, Benignus made a summary of the information and techniques used in 154 Kansas high schools in 1956-1957 for helping students select their ninth grade mathematics subject. Information derived from this survey indicated that the criterion most frequently used for determining the mathematics assignment of ninth grade pupils was previous eighth grade mathematics marks. This criterion was used by approximately

---

1. G. H. Ayres, "Predicting Success in Algebra," School and Society, January 6, 1934. pp. 17-18.

2. Harl R. Douglass, "The Prediction of Pupil Success in High School Mathematics," The Mathematics Teacher, December, 1935. pp. 389-504.

3. Richard Dickter, "Predicting Algebraic Ability," School Review, October, 1933. pp. 604-606.

4. Robert Benignus, Information and Techniques Used in Selected Kansas Schools for Helping Students Elect Their Ninth Grade Mathematics Subject. Unpublished Master's Report, Kansas State College, Manhattan, Kansas, 1958.

ninety percent of the 154 schools responding to the survey. Other criteria used in order of frequency of responses were intelligent quotients, anecdotal records by previous teachers, counseling and results of standardized mathematics tests. Administrators in Kansas seemed to recognize that a problem existed in the assigning of ninth grade mathematics pupils, and most of them indicated there was room for improvement in their programs.

The review of literature was very helpful in structuring the present study, in that it gave a good indication as to the usefulness of various criterion for predicting success in mathematics, such as intelligent quotients, previous accomplishments in mathematics, and standardized tests. It also brought to light the results of previous studies with which the results of the present study might be compared.

STATEMENT OF PROBLEM AND PROCEDURE

The curriculum of Manhattan Junior High School offers four mathematics courses to ninth grade students. These are general mathematics and algebra, which are open to all students, and advanced algebra and geometry which are open only to a few carefully selected students. The choice between algebra and mathematics is left to the student with the advice of the counselor. The classes of advanced algebra and geometry are not open to all students, but only to those whom the counselors and mathematics teachers feel have the necessary ability to succeed in these more advanced courses. Mathematics prognosis tests, DAT results, and grades received in former mathematics courses are used as criteria to decide which students may enroll in advanced algebra and geometry.

It was believed that some definite facts about the ability and mathematical success of students who had already gone through the various mathematics courses would be useful in counseling prospective ninth grade mathematics students of the future. By looking at what students of various abilities had achieved in the past, it was thought to be possible to demonstrate what the future student's chances for success were by looking at his past achievement and abilities.

The sample consisted of the 350 ninth grade students of Manhattan Junior High School during the school year 1961-1962.

The study was set up so as to compare the ninth grade mathematics achievement of these students as measured by the grades received in ninth grade mathematics courses with the following factors:

1) Grades received in eighth grade mathematics courses.

2) Grade rank achieved on the Arithmetic Reasoning and Arithmetic Computation Batteries of the Stanford Achievement Test, which was taken by the students in grade six.

3) Percentile rank achieved on the Numberical Ability Part of the Differential Aptitude Test, which was taken by the students in grade eight.

4) I. Q. score, as measured by the Henmon-Nelson I. Q. test.

The statistical presentation of this material was accomplished through the use of expectancy tables. Presentation of the data in the form of correlation coefficients was considered, but it was felt that the expectancy table was a more practical means of presentation. By the use of expectancy tables, the counselor is able to translate the results into "chances of success" statements.[1]

The grades received by the students in all four mathematics courses were compared with the four factors mentioned above making a total of sixteen expectancy tables in the presentation of the data.

---

1. George K. Bennett, Harold G. Seashore, and Alexander G. Wesman, Differential Aptitude Test Manual. The Psychological Corporation, New York, 1959.

It should be mentioned that all students took the same mathematics course in the eighth grade with the exception of the one class of geometry. These students, who were selected as having superior potentialities at the end of their seventh grade work, took algebra as eighth graders.

DISCUSSION OF FINDINGS

Table 1 reveals that the students had more success in ninth grade general mathematics than they had had in eighth grade mathematics. In fact, their grade in general mathematics in ninth grade averaged almost one whole grade

Table 1. Expectancy table for the prediction of ninth grade general mathematics grades in Manhattan Junior High School using eighth grade mathematics grades as criterion.

Grades in 8th Grade Math.		General Mathematics Grades in 9th Grade F	D	C	B	A	Total
A	No.					1	1
	%					100%	1%
B	No.			2	10	3	15
	%			14%	66%	20%	14%
C	No.		1	19	23	2	45
	%		2%	43%	51%	4%	40%
D	No.	1	14	19	5		39
	%	2%	36%	49%	13%		35%
F	No.	2	8	1			11
	%	18%	73%	9%			10%

higher than the grade received in eighth grade mathematics. This was especially true among those students receiving the low grades. For example, of the 39 students receiving D's in eighth grade mathematics, 24 or 62 percent of them received C's or better in ninth grade general mathematics, and of the 11

students who received F's in eighth grade mathematics, nine of them or 82 percent received D's of better in ninth grade mathematics. The A's and B's from eighth grade repeated to a large extent, and the C's from eighth grade were for the most part about equally divided between C's and B's in ninth grade.

The trend to achieve higher grades in ninth grade general mathematics was probably due to the fact that the competition was not nearly so keen in ninth grade general mathematics. Except for one accelerated class who took algebra, the eighth grade mathematics classes were not grouped according to ability. Thus, there were a large number of students who made D's and F's in eighth grade mathematics who, when entering ninth grade general mathematics found the competition not nearly so keen because of the fact that the better students were then in algebra courses and no longer furnishing competition for these weaker students. This fact is made clearer by noticing that only one student took ninth grade general mathematics who had earned an "A" in eighth grade mathematics. The rest, of course, were enrolled in algebra and geometry courses.

This would indicate to the student of the future enrolling in ninth grade mathematics that even though he has received an F in eighth grade mathematics, on the basis of what others have done before him, he has nine chances out of eleven of passing the ninth grade course with a D or better if he takes general mathematics. The same would not hold true of algebra in ninth grade as we shall see later.

In Table 2, we see the reverse trend in operation. In comparing ninth grade algebra marks with marks received in eighth grade mathematics courses, there is a tendency for the student to receive a lower grade in algebra than was received in eighth grade mathematics. Of the 35 students taking algebra who had received an A in eighth grade mathematics, only nine,

Table 2. Expectancy table for the prediction of ninth grade algebra grades in Manhattan Junior High School using eighth grade mathematics grades as criterion.

Grades in 8th Grade Math.		Algebra Grades in 9th Grade F	D	C	B	A	Total
A	No.		1	6	19	9	35
	%		3%	17%	54%	26%	30%
B	No.		11	39	16		66
	%		17%	60%	23%		54%
C	No.		9	5			14
	%		64%	36%			11%
D	No.		6				6
	%		100%				5%
F	No.						
	%						

or 26 percent received an A in algebra, and seven received C's or lower. The same is true of those receiving B's in eighth grade mathematics, with only 16 out of 66 or 23 percent making B's in algebra in ninth grade.

It is also interesting to note that the six students enroll-

ed in algebra who had received D's in eighth grade mathematics all received D's also in ninth grade algebra. It would seem reasonable then, to encourage those who receive a D in eighth grade mathematics to take general mathematics in ninth grade where their chances of getting a C or better would be 24 out of 39, while their chances of getting a grade above a D in algebra were practically nil. It seems reasonable to explore the possibility of initiating a policy whereby only those who have received a C or better in eighth grade mathematics would be allowed to take algebra in ninth grade.

Beyond the scope of this study, but an interesting question to raise at this time would be whether these students did not possess the mental ability to succeed in algebra, or whether they did not yet possess the "mathematical readiness" some people believe to be necessary before a student can grasp algebraic concepts to a satisfactory degree.

Table 3 which deals with advanced algebra grades as compared to eighth grade mathematics grades shows the same trend as Table 2 only the trend is even more pronounced in the relation of eighth grade mathematics grades to grades received in advanced algebra in the ninth grade.

Of the twelve students taking advanced algebra who had received A's in eighth grade mathematics, only two or 17 percent repeated with A's in advanced algebra, while two of the same groups received only C's in advanced algebra. The contrast of students who received B's and C's is even more striking.

Ten students received B's in eighth grade mathematics and all ten dropped to C's in advanced algebra, and the one student who received a C in eighth grade mathematics dropped to a D.

On the basis of this evidence, it would seem reasonable to recommend that no student be allowed to take advanced algebra who had not received a B or better in eighth grade mathematics.

Table 3. Expectancy table for the prediction of ninth grade advanced algebra grades in Manhattan Junior High School using eighth grade mathematics grades as criterion.

Grades in 8th Grade Math.		Advanced Algebra Grades in 9th Grade F	D	C	B	A	Total
A	No.			2	8	2	12
	%			17%	66%	17%	52%
B	No.			10			10
	%			100%			44%
C	No.		1				1
	%		100%				4%
D	No.						
	%						
F	No.						
	%						

The students whose grades are presented in Table 4 were chosen the previous year to take algebra as eighth graders. After completing the algebra course in grade eight, geometry is the only mathematics course open to them so this graph is not too useful as a screening device, but it helps show the

Table 4. Expectancy table for the prediction of ninth grade geometry grades in Manhattan Junior High School using eighth grade algebra grades as criterion.

Grades in 8th Grade Algebra		Geometry Grades in 9th Grade F	D	C	B	A	Total
A	No.			3	8	8	19
	%			16%	42%	42%	61%
B	No.			6	6		12
	%			50%	50%		39%
C	No.						
	%						
D	No.						
	%						
F	No.						
	%						

prospective ninth grade geometry student what his chances for various degrees of success are.

It can be readily seen that only those who achieved grades of A or B in eighth grade algebra were allowed to take geometry in ninth grade. None of these students received D's or F's in geometry although nine or 27 percent fell to a C.

To summarize the group of tables in which we compared grades received in various ninth grade mathematics courses with grades received in eighth grade mathematics courses we might say that there is a definite tendency for the student taking general mathematics to achieve a higher grade than was

achieved in eighth grade mathematics. This is due probably to the lessening of competition because the better students went into algebra and geometry classes.

For the students taking algebra, advanced algebra, and geometry, the reverse was true. They tended to received lower grades, probably because of harder material, and also because the poorer students were no longer in class to fill in the lower parts of the grading scale.

In Table 5, we see a comparison of the ninth grade general mathematics grades and the grade rank achieved by the students in taking the Stanford Achievement Test in grade six.

It would seem that these results provide a pretty fair

Table 5. Expectancy table for the prediction of ninth grade general mathematics grades in Manhattan Junior High School using Stanford Achievement Test scores as criterion.

Stanford Achieve. Test Results		General Mathematics Grades in 9th Grade F	D	C	B	A	Total
8.0 and over	No.			1	6	3	10
	%			10%	60%	30%	10%
7.0-7.9	No.		3	7	10	3	23
	%		13%	30%	44%	13%	24%
6.0-6.9	No.		3	10	15		28
	%		11%	36%	53%		29%
5.0-5.9	No.	1	4	12	4		21
	%	5%	19%	57%	19%		22%
Under 5.0	No.	1	11	3			15
	%	7%	73%	20%			15%

means of predicting success. All fifteen students ranking lower than grade five on the Stanford Achievement Test received C's or lower in ninth grade general mathematics, with 11 students or 73 percent receiving a D.

When we compare the students who achieved a rank of fifth grade on the Stanford Test with those who achieved a rank of sixth grade, we see very little difference except that those with a sixth grade rank achieved a higher percentage of B's. This group achieved 53 percent B's, while the group with the fifth grade rank recorded only 19 percent B's.

With the seventh grade ranking, we find the first students who recorded A's in general mathematics, and in the eighth grade rank, 90 percent recorded B's or A's in ninth grade general mathematics.

According to Table 6, it would seem unwise to place students in algebra if they had a Stanford Achievement Test rank of less than seventh grade, because 54 percent of these students achieved grades of D's and F's in algebra in ninth grade.

In Tables 7 and 8 we see that all students except one who took either advanced algebra or geometry ranked at least on the seventh grade level on the Stanford Achievement Test. In fact, all students who took geometry except one achieved a rank of grade eight or higher.

It is interesting to note here the high level of students who are selected for these two advanced classes of advanced algebra and geometry as measured by the Stanford Achievement Test.

Table 6. Expectancy table for the prediction of ninth grade algebra grades in Manhattan Junior High School using Stanford Achievement Test scores as criterion.

Stanford Achieve. Test Results		Algebra Grades in 9th Grade F	D	C	B	A	Total
8.0 and over	No.		2	12	9	3	26
	%		8%	46%	35%	11%	27%
7.0-7.9	No.		6	19	16	3	44
	%		13%	43%	37%	7%	46%
6.0-6.9	No.		11	8	2		21
	%		52%	38%	10%		22%
5.0-5.9	No.		3	2			5
	%		60%	40%			5%
Under 5.0	No.						
	%						

Table 7. Expectancy table for the prediction of ninth grade advanced algebra grades in Manhattan Junior High School using Stanford Achievement Test scores as criterion.

Stanford Achieve. Test Results		Advanced Algebra Grades in 9th Grade F	D	C	B	A	Total
8.0 and over	No.			3	3	1	7
	%			43%	43%	14%	50%
7.0-7.9	No.			4	1	1	6
	%			66%	17%	17%	43%
6.0-6.9	No.			1			1
	%			100%			7%
5.0-5.9	No.						
	%						
Under 5.0	No.						
	%						

Table 8. Expectancy table for the prediction of ninth grade geometry grades in Manhattan Junior High School using Stanford Achievement Test scores as criterion.

Stanford Achieve. Test Results		Geometry Grades in 9th Grade F	D	C	B	A	Total
8.0 and over	No.			9	12	4	25
	%			36%	48%	16%	96%
7.0-7.9	No.					1	1
	%					100%	4%
6.0-6.9	No.						
	%						
5.0-5.9	No.						
	%						
Under 5.0	No.						
	%						

The Numerical score of the Differential Aptitude Test, which is compared with ninth grade general mathematics grades in Table 9 was expected to be one of the best means of prediction at the start of this study, but it didn't turn out to be as good a predictor as was originally believed.

It can still be of some use, however. Of the 40 students taking general mathematics who achieved a percentile rank of from one to twenty on the DAT, 24 or 60 percent received grades of D or lower in ninth grade general mathematics.

Of the 21-40 percentile group, 63 percent received C's and of the 41-60 group, 53 percent received B's. There were no students who achieved a DAT percentile rank of 60 or over who

Table 9. Expectancy table for the prediction of ninth grade general mathematics grades in Manhattan Junior High School using DAT percentile ranks as criterion.

DAT Percentile Rank		General Mathematics Grades in 9th Grade F	D	C	B	A	Total
81-100	No.			2	1	1	4
	%			50%	25%	25%	4%
61-80	No.			8	8	3	19
	%			42%	42%	16%	14%
41-60	No.			17	20	1	38
	%			44%	53%	3%	29%
21-40	No.		3	19	8		30
	%		10%	63%	27%		23%
1-20	No.	3	21	10	5	1	40
	%	8%	52%	25%	13%	2%	30%

received any grade in general mathematics lower than C. This criterion for success would seem to be very useful when comparing with ninth grade general mathematics students.

Unfortunately, the DAT scores don't seem to be as accurate when predicting success in the more advanced ninth grade courses. The tendency still seems to be there, however. Table 10 shows that of the 45 students in algebra who ranked below the 60th percentile on the DAT, 48 percent received D's or below in ninth grade algebra.

On the other hand, of the 96 students taking algebra who ranked above the 60th percentile on the DAT, 90 percent received

Table 10. Expectancy table for the prediction of ninth grade algebra grades in Manhattan Junior High School using DAT percentile ranks as criterion.

DAT Percentile Rank		Algebra Grades in 9th Grade F	D	C	B	A	Total
81-100	No.		2	15	19	7	43
	%		5%	35%	44%	16%	31%
61-80	No.	1	6	28	17	1	53
	%	2%	11%	53%	32%	2%	38%
41-60	No.		12	12	4	1	29
	%		41%	41%	14%	4%	20%
21-40	No.		10	3	2		15
	%		67%	20%	13%		10%
1-20	No.			1			1
	%			100%			1%

C's or over, with 45 percent receiving B's and A's. Of the total of 168 students who ranked above the 60th percentile, 156 or 93 percent received C's or better no matter which mathematics course they took.

By looking at Tables 11 and 12, it can be seen that the students in these two advanced classes were also of very high caliber, with only one student in advanced algebra who ranked lower than the 60th percentile on the DAT. By the same token, there are only two students in this category taking geometry.

In Table 13, the grades of ninth grade general mathematics students are compared with the IQ's of the students as measured by the Henmon-Nelson IQ Test. It may be noted that of those

Table 11. Expectancy table for the prediction of ninth grade advanced algebra grades in Manhattan Junior High School using DAT percentile ranks as criterion.

DAT Percentile Rank		Advanced Algebra Grades in 9th Grade F	D	C	B	A	Total
81-100	No.			4	6	2	12
	%			33%	50%	17%	55%
61-80	No.		1	7	1		9
	%		11%	78%	11%		41%
41-60	No.			1			1
	%			100%			4%
21-40	No.						
	%						
1-20	No.						
	%						

Table 12. Expectancy table for the prediction of ninth grade geometry grades in Manhattan Junior High School using DAT percentile ranks as criterion.

DAT Percentile Rank		Geometry Grades in 9th Grade F	D	C	B	A	Total
81-100	No.			5	8	8	21
	%			24%	38%	38%	70%
61-80	No.			2	5		7
	%			29%	71%		23%
41-60	No.			1	1		2
	%			50%	50%		7%
21-40	No.						
	%						
1-20	No.						
	%						

Table 13. Expectancy table for the prediction of ninth grade general mathematics grades in Manhattan Junior High School using Henmon-Nelson IQ as criterion.

Intelligence Quotient		General Mathematics Grades in 9th Grade					
		F	D	C	B	A	Total
Over 130	No.			1	2	1	4
	%			25%	50%	25%	3%
111-130	No.		1	8	12	3	24
	%		4%	34%	50%	12%	18%
91-110	No.	1	9	41	24	2	77
	%	1%	12%	53%	31%	3%	56%
71-90	No.	2	15	10	3		30
	%	7%	50%	33%	10%		21%
70 and Below	No.	1	1				2
	%	50%	50%				2%

students with a measured IQ of less than 70, 100 percent received D's and F's. Of those with IQ's of 71-90, 57 percent received D's and F's in general mathematics, while only 10 percent received B's, and there were no A's in this group at all. Of those "average" students with IQ's of 91-110, there is a pretty good distribution, with 53 percent in this group receiving C's. There is however, a predominance of B's over D's in this category with 31 percent and 12 percent respectively. This same tendency of general mathematics students to receive grades a little higher then might be expected, was encountered also when comparing eighth grade mathematics grades to ninth

grade general mathematics grades. It was mentioned then, and might be reiterated here, that this is probably due to the fact that the better students who would normally fill in the upper portions of the grading scale are enrolled in algebra, etc.

In Table 14, we see this opposite trend in operation again, where the "average" student, with an IQ of from 91-110, tends to receive lower grades. For example, 39 percent of these students received D's in algebra as opposed to only 12 percent in general mathematics.

For those students taking algebra, the predominance of C's fall into the group of students having IQ's of 111-130, with 49 percent in this category.

Table 14. Expectancy table for the prediction of ninth grade algebra grades in Manhattan Junior High School using Henmon-Nelson IQ as criterion.

Intelligence Quotient		Algebra Grades in 9th Grade F	D	C	B	A	Total
Over 130	No.		1	4	7	3	15
	%		7%	26%	47%	20%	11%
111-130	No.		8	34	19	8	69
	%		11%	49%	29%	11%	48%
91-110	No.	1	22	19	12	2	56
	%	2%	39%	34%	21%	4%	39%
71-90	No.		1		1		2
	%		50%		50%		2%
70 and Below	No.						
	%						

About the only significant statement that can be said about the advanced algebra and geometry students as shown in Tables 15 and 16 is that there are few students with low IQ's in these classes, with only 9 percent having IQ's of less than 110. This is understandable, however, due to the fact that these students are selected with regard to their ability as measured by intelligence and aptitude tests as well as their past performance in mathematics classes.

It would seem from this study that all of these criteria lose the distinct predictive value that is found among lower ranking students, when applied to these superior students enrolled in accelerated mathematics courses. The only group-

Table 15. Expectancy table for the prediction of ninth grade advanced algebra grades in Manhattan Junior High School using Henmon-Nelson IQ as criterion.

Intelligence Quotient		Advanced Algebra Grades in 9th Grade F	D	C	B	A	Total
Over 130	No.			4	1		5
	%			80%	20%		22%
111-130	No.		1	6	5	2	14
	%		7%	43%	36%	14%	61%
91-110	No.			3		1	4
	%			75%		25%	17%
71-90	No.						
	%						
70 and Below	No.						
	%						

Table 16. Expectancy table for the prediction of ninth grade geometry grades in Manhattan Junior High School using Henmon-Nelson IQ as criterion.

Intelligence Quotient		Geometry Grades in 9th Grade F	D	C	B	A	Total
Over 130	No.			3	7	6	16
	%			19%	44%	37%	52%
111-130	No.			5	7	2	14
	%			36%	50%	14%	45%
91-110	No.			1			1
	%			100%			3%
71-90	No.						
	%						
70 and Below	No.						
	%						

ing of grades that are evident in this category is the fact that there are almost no grades below C, which we would expect in classes grouped according to high scholastic and mathematical ability.

SUMMARY AND CONCLUSIONS

In general, the entire educational system is vitally and constantly concerned with prognosis. In the promotion system, every success and every failure is in a real sense a predictive factor.

The growing demand by society for people adequately prepared in mathematics has brought about an increased interest and enrollment in mathematics courses on all levels. To maintain high standards of achievement, there must be a sifting and selecting of students. All students with a fair chance of succeeding should be encouraged to enroll provided, of course, that their interests and ambitions are commensurate with their abilities. In addition to ability and ambition, a student must have a background of skills and habits, and adequate information upon which to proceed when undertaking the study of algebra and other advanced mathematics courses.

One purpose of this study was to discover if there is an abundance of information on the student record cards, if properly used, to aid materially in counseling students concerning their study of mathematics. Consequently, this investigation sought answers to the following questions:

1) What is the relationship between eighth grade mathematics grades and grades received in ninth grade mathematics?

2) What is the relationship between the grade rank achieved on the Arithmetic Reasoning and Arithmetic Computation Batteries of the Stanford Achievement Test and the grades received in ninth grade mathematics?

3) What is the relationship between the percentile rank achieved on the Numerical Ability part of the Differential Aptitude Test and the grades received in ninth grade mathematics?

4) What is the relationship between the student's IQ score as measured by the Henmon-Nelson Test and the grades received in ninth grade mathematics?

The answers to these questions were sought in the student record files. The eighth grade achievement, mental test scores, achievement test scores, and aptitude test scores of the students along with grades received in ninth grade mathematics courses were assembled to be studied.

It was felt that it would be useful to establish some cut-off points below which success in the particular subject seemed doubtful.

Probably the cut-off point that is most obvious as a result of this study is the B level achieved in eighth grade mathematics courses. Any student with a C or less should probably be advised to take general mathematics in ninth grade, because his chances of achieving a C or better in algebra or advanced algebra are not very great according to this study. Therefore, it seems reasonable to explore the possibility of initiating a policy whereby only those who have received at least a C, and preferably a B in eighth grade mathematics be allowed to take algebra in ninth grade.

With regard to the Stanford Achievement Test, it would seem that a student should have achieved a grade rank of at least grade six to enroll in ninth grade algebra, and at least grade seven and preferably grade eight to be selected for

advanced algebra or geometry.

To achieve any degree of success in all ninth grade mathematics courses, but especially algebra, advanced algebra, and geometry, it was found that the student generally was to achieve a percentile rank on the Differential Aptitude Test of 40 or over.

With regard to IQ's, it would seem that if the student had an IQ rating of less than 90, he should definitely not attempt algebra, and even in general mathematics, the competition would be very keen for the individual.

After extensively comparing the four criteria used here by which to predict grades, it would seem that of the four means used, the most accurate would definitely be the grades achieved in eighth grade mathematics, and the poorest and least reliable method would be the use of IQ scores.

It is believed that the above study will be of good use when counseling prospective ninth grade mathematics students in Manhattan Junior High School. It's usefulness will certainly depreciate as the years go by, primarily because of the teacher turn-over and the consequent change in grading technique.

This study has given the writer a deeper understanding of the problems encountered, as well as the techniques involved in doing research of this type and also in counseling junior high school students.

ACKNOWLEDGMENTS

Sincere appreciation is expressed to Dr. H. Leigh Baker, Professor of Education and Consultant in Guidance Services, Kansas State University, for his valuable guidance and assistance in the completion of this report.

The writer also wishes to express appreciation to the administrative and guidance staff of Manhattan Junior High School for making the student records available for use in collecting the data used in this report.

Special thanks is expressed to the writer's wife, Virginia, without whose patience, encouragement, and clerical ability the completion of this report could never have been realized.

LITERATURE CITED

1. Ayres, G. H. "Predicting Success in Algebra". School and Society, January 6, 1934, 39: 17-18.

2. Benignus, Robert. "Information and Techniques Used in Selected Kansas Schools for Helping Students Elect Their Ninth Grade Mathematics Subject," (Unpublished Master's Report, Kansas State College, Manhattan, Kansas, 1958)

3. Bennett, George K., Seashore, Harold G., Wesman, Alexander G. Differential Aptitude Test Manual, The Psychological Corporation, New York, 1959.

4. Dickter, Richard. "Predicting Algebraic Ability." School Review, October, 1933, 41: 604-606.

5. Douglass, Harl R. "The Prediction of Pupil Success in High School Mathematics." The Mathematics Teacher, December, 1935, 28: 489-504.

6. Guiler, W. S. "Forecasting Achievement in Elementary Algebra." Journal of Educational Research, September, 1944, 38: 25.

7. Krug, Edward A. Curriculum Planning. New York: Harper and Brothers, 1954.

8. Layton, R. B. "A Study of Prognosis in High School Algebra." Journal of Educational Research, April, 1941, 34: 601-605.

9. Lee, J. Murray, and Hughes, W. Hardin. "Predicting Success in Algebra and Geometry." School Review, March, 1934, 40: 188-196.

10. McMillan, LaVerne Ruth. "A Comparative Study of the Prediction of Achievement in Ninth Grade Algebra." (Unpublished Master's Thesis, The University of Texas, 1956)

11. Orleans, Joseph B. "A Study of Prognosis of Probable Success in Algebra and in Geometry." The Mathematics Teacher, May, 1934, 27: 225-246.

12. "The Place of Mathematics in Secondary Education." National Council of Teachers of Mathematics Fifteenth Yearbook. New York: Bureau of Publication, Teachers College, Columbia University, 1940.

13. "The Reorganization of Mathematics in Secondary Education." The National Committee on Mathematical Requirements. Boston: Houghton-Mifflin Company, 1927.

14. Rogers, Agnes L. "Experimental Tests of Mathematical Ability and Their Prognostic Value." Teachers College Contributions to Education. New York: Teachers College, Columbia University, 1918.

15. Shaw, Geraldine Sax. "Prediction of Success in Elementary Algebra." The Mathematics Teacher, March, 1956, 49: 173-178.

16. Travers, Robert M. W. Educational Measurement, New York: The Macmillan Company, 1955.

PREDICTING SUCCESS OF NINTH GRADE MATHEMATICS STUDENTS IN MANHATTAN JUNIOR HIGH SCHOOL

by

JAMES L. REZAC

B. A., St. Benedict's College, 1960

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Education

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1962

Due to the recent emphasis on mathematics in our school system, the problems and obligations of the mathematics teachers have been greatly increased. This emphasis has, by the same token, added to the responsibilities of administrators and counselors who must seek methods of encouraging those who have the ability and interest to embark on successful mathematics courses.

The purpose of this study was to predict the success of ninth grade mathematics students in Manhattan Junior High School. The four mathematics courses offered to ninth graders are: general mathematics and algebra, which are open to all students, and advanced algebra and geometry which are open only to a few carefully selected students.

The sample consisted of the 350 ninth grade students of Manhattan Junior High School during the school year 1961-1962. The study was set up so as to compare the ninth grade mathematics achievement of these students as measured by the grades received in ninth grade mathematics courses with the following factors:

1) Grades received in eighth grade mathematics courses.

2) Grade rank achieved on the Arithmetic Reasoning and Arithmetic Computation Batteries of the Stanford Achievement Test, which was taken by the students in grade six.

3) Percentile rank achieved on the Numerical Ability Part of the Differential Aptitude Test, which was taken by the students in grade eight.

4) I. Q. score, as measured by the Henmon-Nelson I. Q. Test.

By looking at what students of various abilities had achieved in the past, it was thought to be possible to predict what a future student's chances for success might be.

The statistical presentation of this material was accomplished through the use of expectancy tables. The grades received by the students in all four mathematics courses were compared with the four factors mentioned above making a total of sixteen expectancy tables. On the basis of the data presented in the expectancy tables, certain conclusions are warranted.

Any student with a grade of C or less in eighth grade mathematics should probably be advised to take general mathematics in ninth grade because his chances of achieving a C or better in algebra or advanced algebra are slight. It would seem reasonable, then, to initiate a policy whereby only those who have received a C, and preferably a B in eighth grade mathematics be allowed to take algebra in ninth grade.

With regard to the Stanford Achievement Test, it would seem that a student should have achieved a rank of at least grade six to enroll in ninth grade algebra, and at least grade seven and preferably grade eight to be selected for advanced algebra or geometry.

To achieve any degree of success in all ninth grade mathematics courses, but especially algebra, advanced algebra, and geometry, it was found that the student generally should

achieve a percentile rank on the Differential Aptitude Test of 40 or over.

With regard to I. Q's, it would seem that if the student had an I. Q. rating of less than 90, he should definitely not attempt algebra.

After extensively comparing the four criteria used here to predict grades, it would seem that of the four means used, the most accurate would definitely be the grades achieved in eighth grade mathematics, and the poorest and least reliable method would be the use of Henmon-Nelson I. Q. scores.